COCOMO II Local Calibration Using Function Points

Mauricio Aguiar

TI Metricas

20th International Forum on COCOMO and Software Cost Modeling
October 25-28, 2005, Los Angeles, California

Agenda - I

- Introduction
  - **The COCOMO Model**
  - **Scope of the Study**
- Model Calibration Framework
  - **Study the Environment and Establish Project Categories**
  - **Select Target Category**
  - **Select Projects to Be Measured**
  - **Determine Actual Effort and Schedule**
  - **Measure Selected Projects in Function Points**
  - **Determine Scale Factors and Effort Multipliers**
  - **Calibrate Model**
  - **Assess Calibration and Analyze Results**

Agenda - II

- Study Results
  - **Organization A**
  - **Organization B**
  - **Organization C**
  - **Organization D**
  - **Organization E**
- Conclusions and Future Work
  - **Using COCOMO II Original Calibration as a Baseline**
  - **Calibration Difficulties, Lessons Learned, and Recommendations**

Introduction

Introduction
The COCOMO Model


- COCOMO and COCOMO II are software engineering cost estimation models
- COCOMO was created by Barry Boehm in the 70's and published in 1981
- COCOMO II updated COCOMO to modern software development practices
  - **COCOMO II.1997**
    - 83 data points, PRED(.30) = 52% – 64% (stratified)
  - **COCOMO II.2000**
    - 161 data points, PRED(.30) = 75% – 80% (stratified)
- Local calibration improves results

Introduction
Scope of Study

- COCOMO II Local calibration – 5 Brazilian organizations
  - **3 government, 2 private**
    - 2 financial institutions
    - 1 service organization
    - 1 IT organization
    - 1 manufacture

  - **All use Function Points as a measure of size**
- Study Goals
  - **Discuss challenges, difficulties, and lessons learned**
  - **Provide results on the use of Function Points as input to COCOMO II**

Model Calibration Framework

Model Calibration Framework

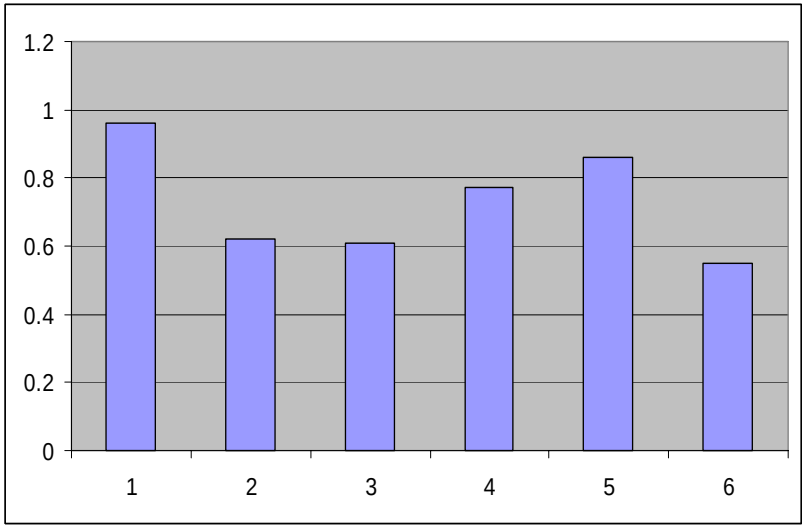
- Data Collection
  - **Study the environment and establish project categories**
  - **Select a target project category**
  - **Select projects to be measured**
  - **Determine actual effort and schedule**
  - **Measure projects in Function Points**
  - **Determine scale factors and effort multipliers**
- Model Calibration
  - **Cailbrate a COCOMO II Model using CALICO[1]**
- Analysis
  - **Assess calibration and analyze results**

[1] CALICO can be downloaded free of charge from http://www.softstarsystems.com

Study Results

Study Results
Organization A

- Goal: to estimate effort and schedule for one project
- 6 completed projects selected out of 8 available
- Projects measured both in SLOC and FP
- Effort and schedule obtained in interviews

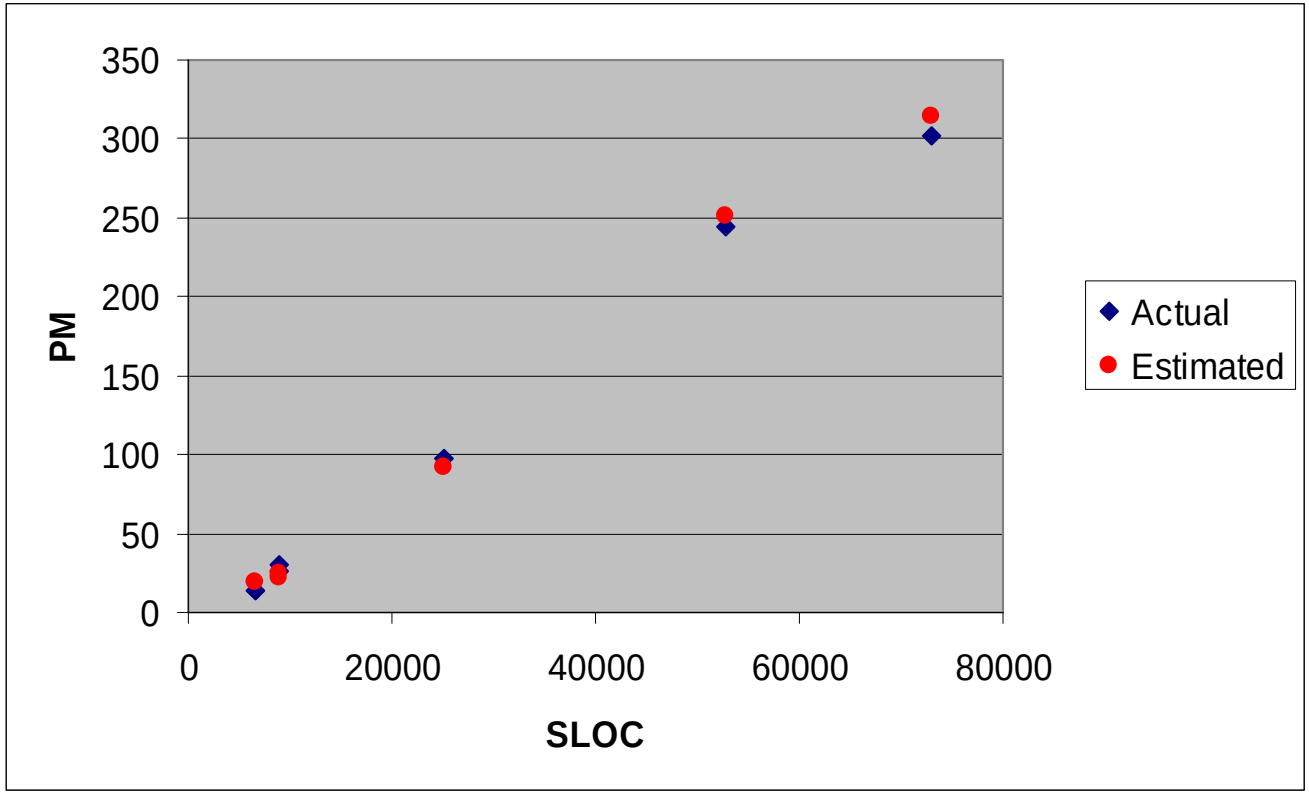


EAF – Mean .73

Std Dev .16

SF - nominal

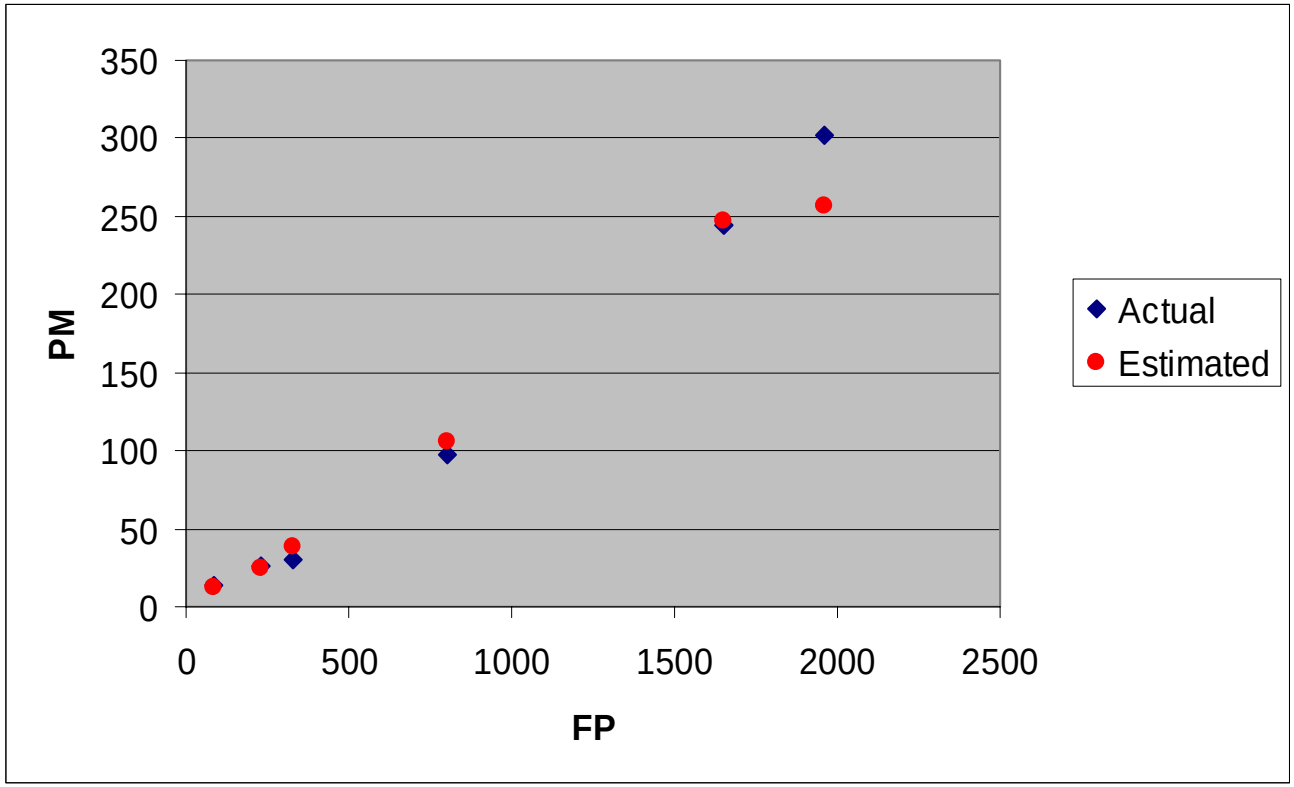
Study Results
Organization A



Calibration Results for SLOC

MRE = 11.68% – PRED(.30) = 83%

Study Results
Organization A



Calibration Results for Function Points

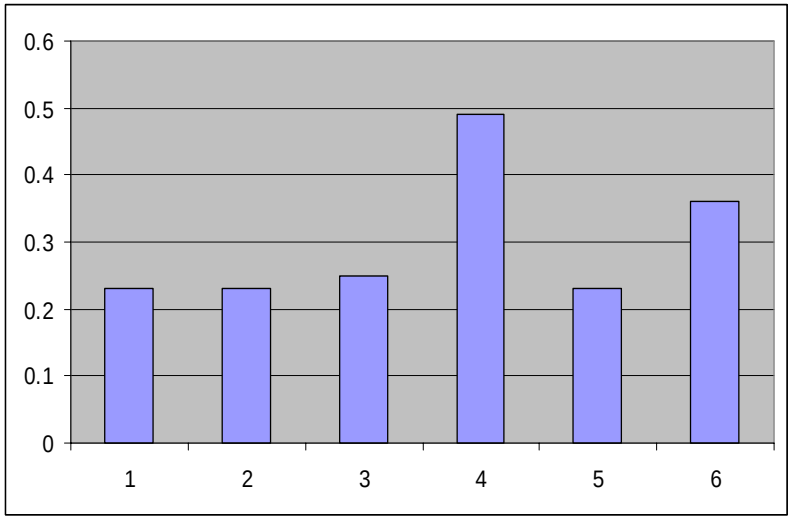
MRE = 11.38% – PRED(.30) = 100%

Study Results
Organization A

- Conclusions
  - **SLOC and FP gave similar results**
  - **Good PRED(.30) values**
  - **New project was estimated using FP estimated size and calibrated model**

Study Results
Organization B

- Goal: to implement a COCOMO II estimation process
- 6 completed projects selected
- Small projects: < 300 FP, 2 to 4 months duration
- Project size estimated in FP (NESMA technique)
- Effort and schedule obtained in interviews

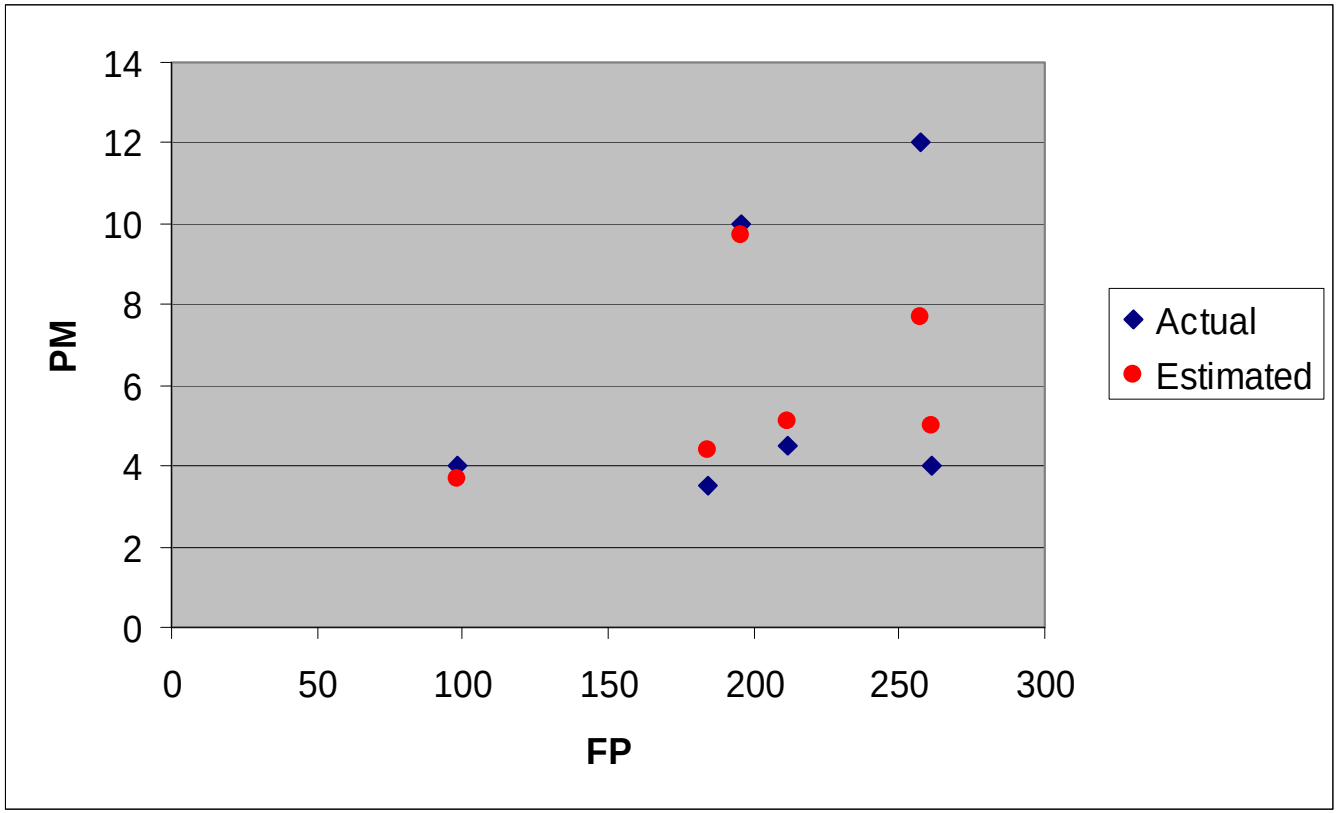


EAF – Mean .30

Std Dev .11

SF - nominal

Study Results
Organization B



Calibration Results

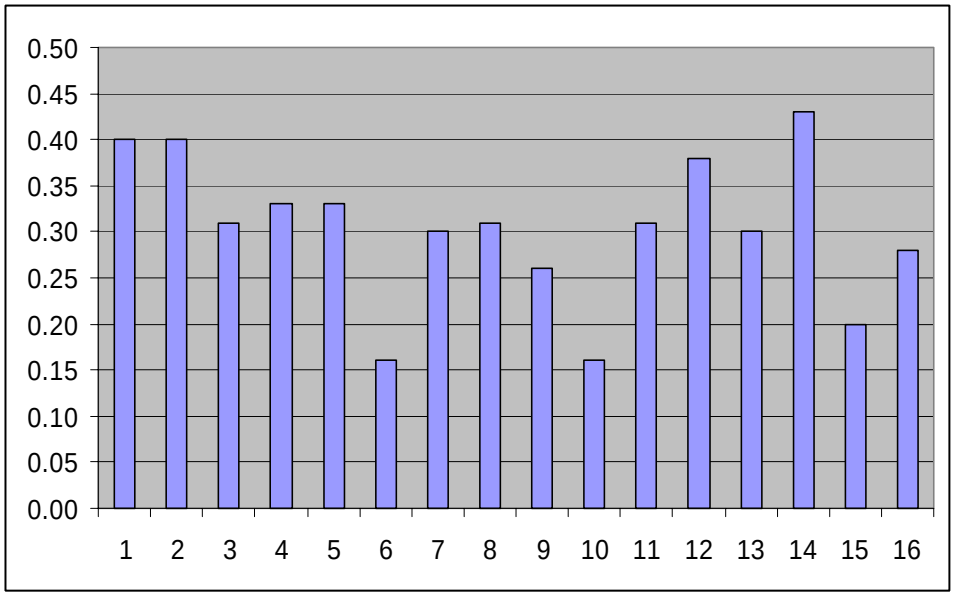
MRE = 18.50% – PRED(.30) = 83%

Study Results
Organization B

- Results considered OK as a first step
  - **PRED(.30) = 83%**
- Next step to collect more projects and recalibrate model

Study Results
Organization C

- Goal: to implement a COCOMO II estimation process
- 16 completed projects selected
- All projects from the same category
- Project size estimated in FP (NESMA technique)
- Effort and schedule obtained in interviews

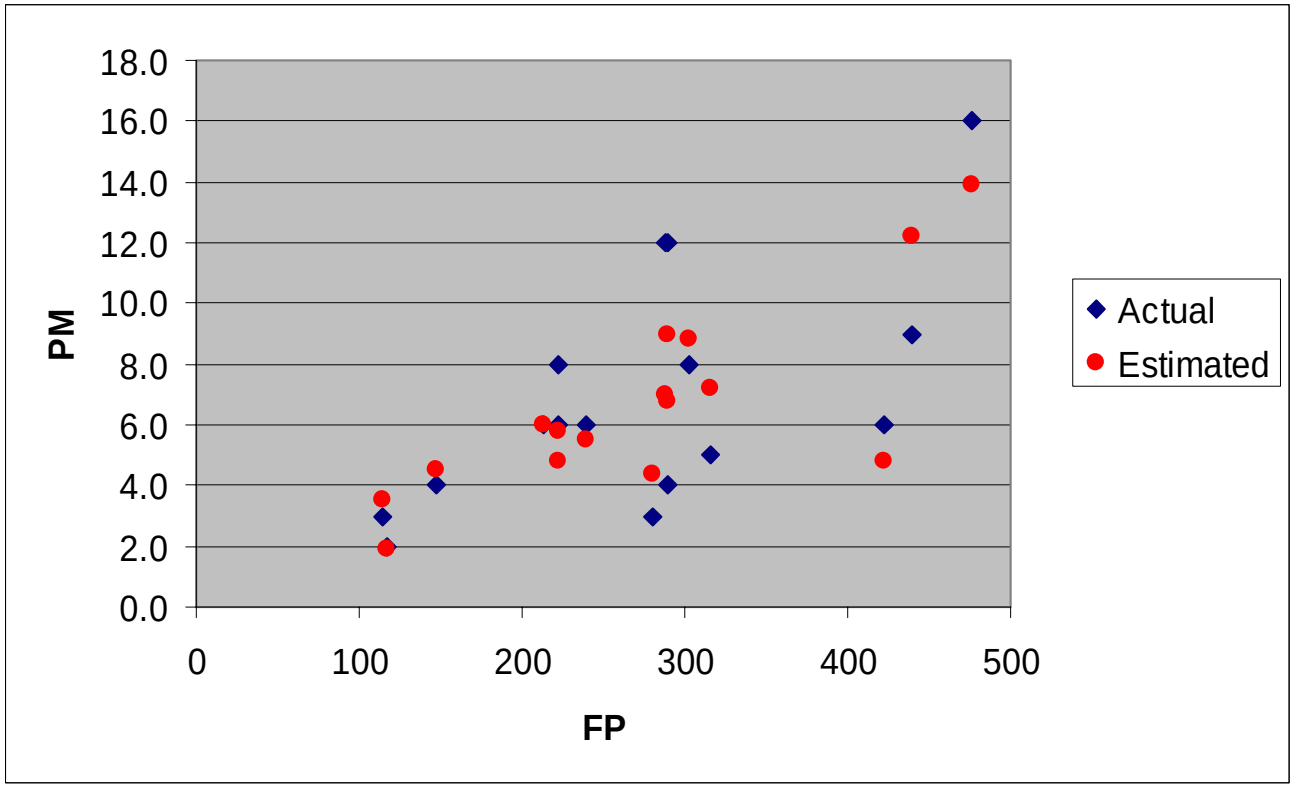


EAF – Mean .30

Std Dev .08

SF - nominal

Study Results
Organization C



Calibration Results

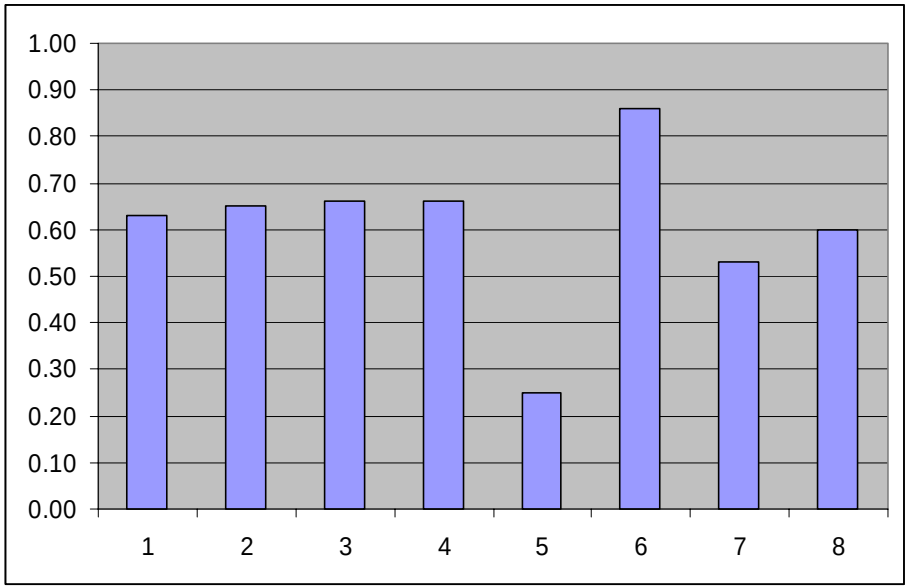
MRE = 29.52% – PRED(.30) = 56%

Study Results
Organization C

- Large variation in effort for the same size
  - **Around 300 FP – 3 to 12 PM effort**
  - **Same situation around 450-500 FP**
- More analysis needed
  - **Stabilize development process**

Study Results
Organization D

- Goal: to implement a COCOMO II estimation process
- 8 completed projects selected
- All from the same platform
- Project size estimated in FP (NESMA technique)
- Effort and schedule obtained in interviews

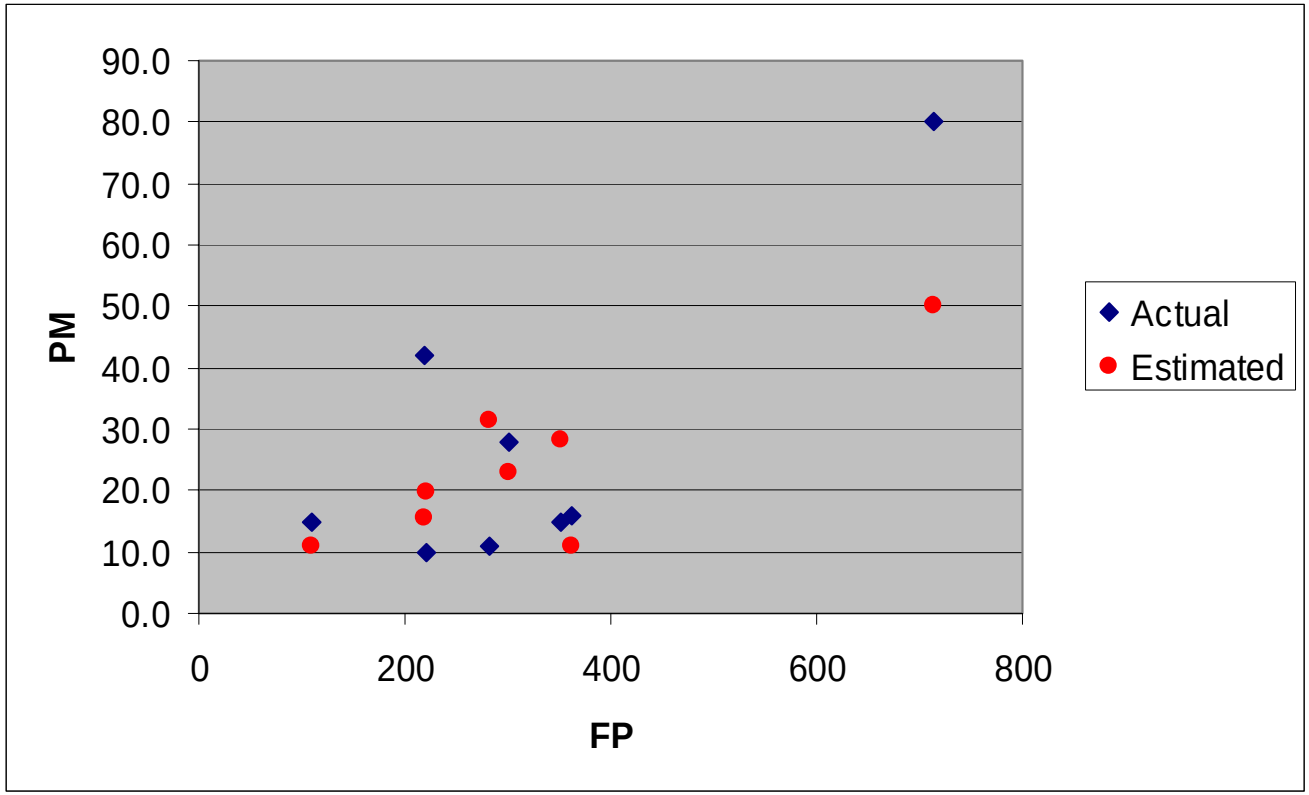


EAF – Mean .61

Std Dev .17

SF - nominal

Study Results
Organization D

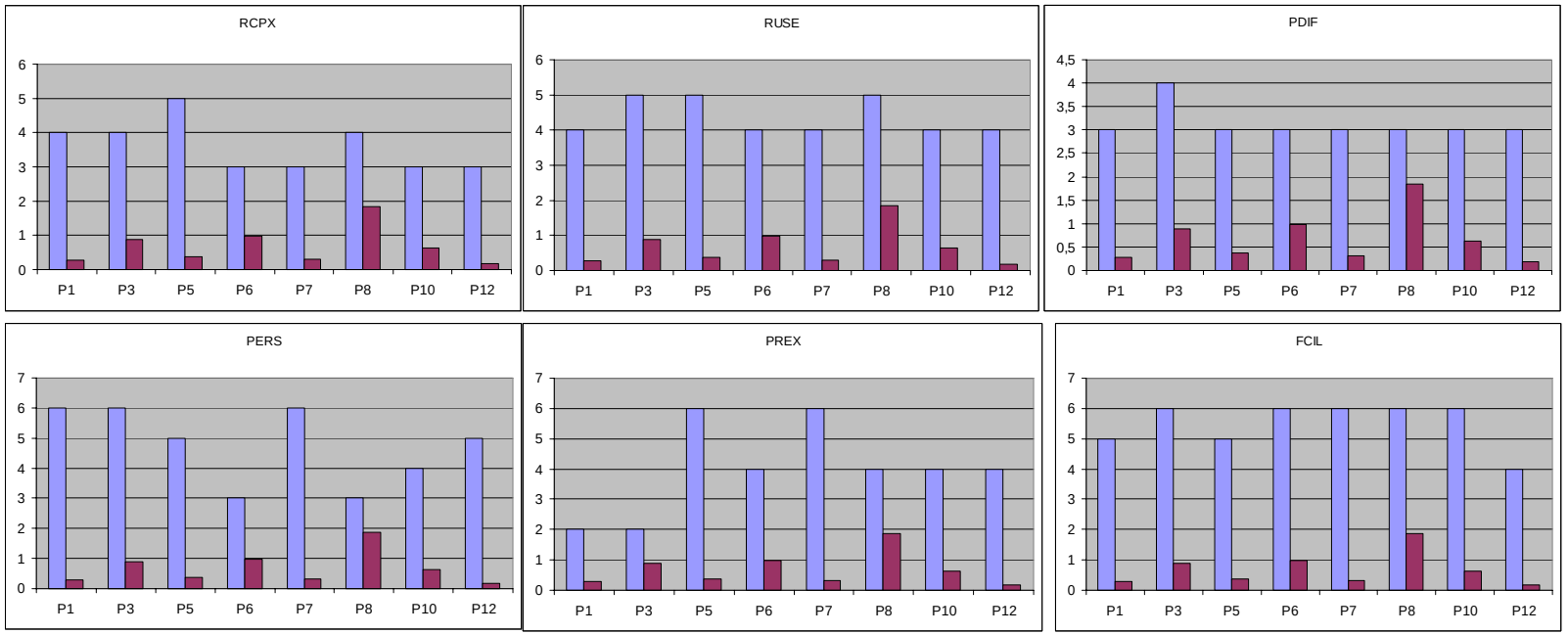


Calibration Results

MRE = 68.24% – PRED(.30) = 25%

Study Results
Organization D

- Graphs used to look for causes of low PRED
  Example:



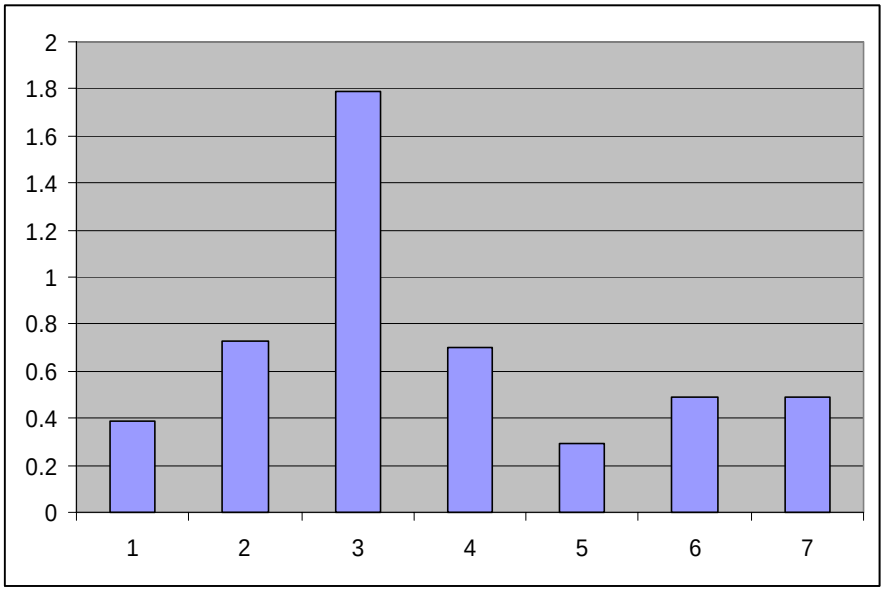
Blue bar: driver rating – Red bar: percent error

Study Results
Organization D

- Potential reasons for low PRED:
  - **Some projects interrupted and then resumed**
  - **Some were 1-person projects**
  - **Inconsistent rating of DATA effort multiplier**
  - **In some cases construction was done by a different organization**
  - **In some cases different software processes were used**
- Resolve problems, add more projects, and recalibrate

Study Results
Organization E

- Goal: to upgrade the organization's estimating process to COCOMO II
- 7 completed projects selected
- Project selection based on availability
- Project size estimated in FP (NESMA technique)
- Effort and schedule obtained in interviews

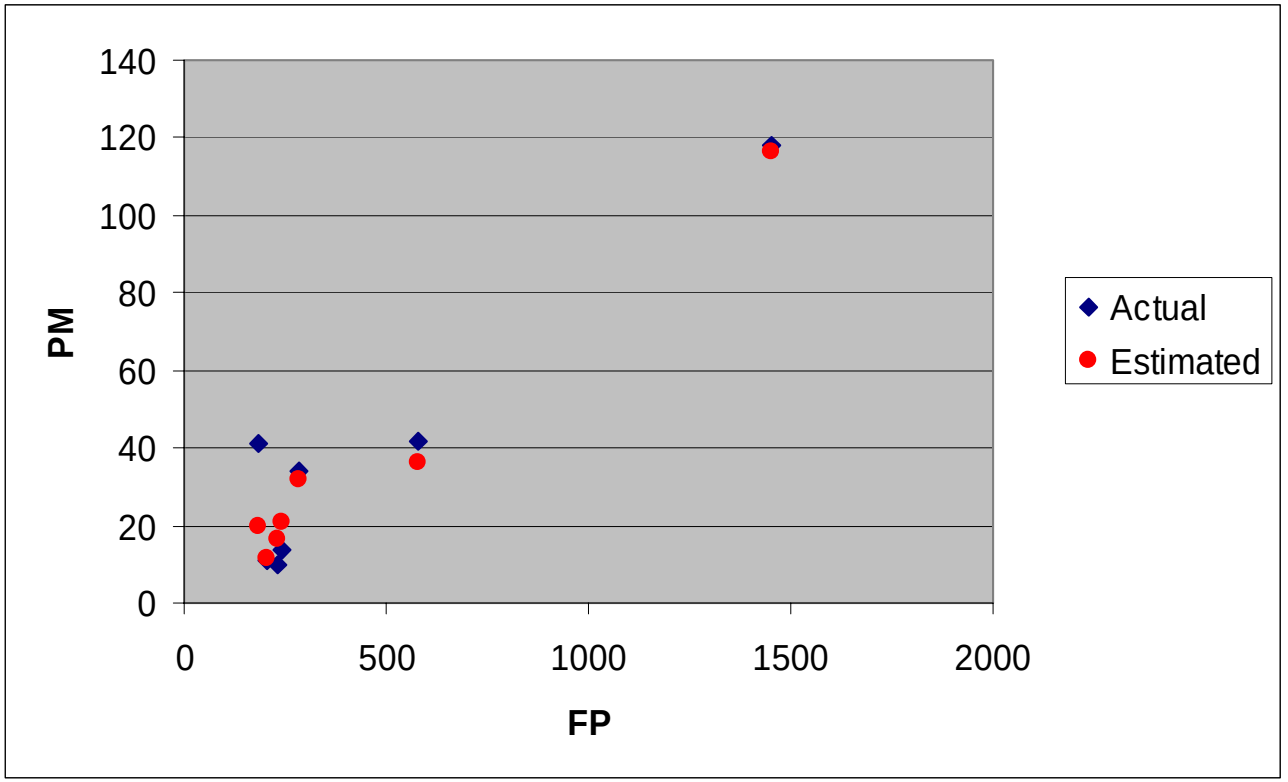


EAF – Mean .70

Std Dev .51

SF - nominal

Study Results
Organization E

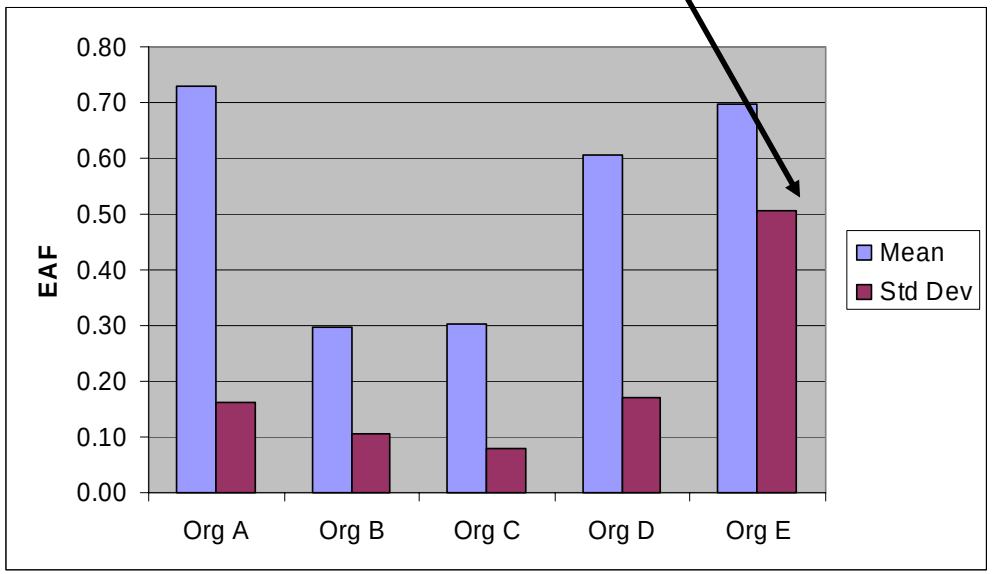


Calibration Results

MRE = 27.42% – PRED(.30) = 57%

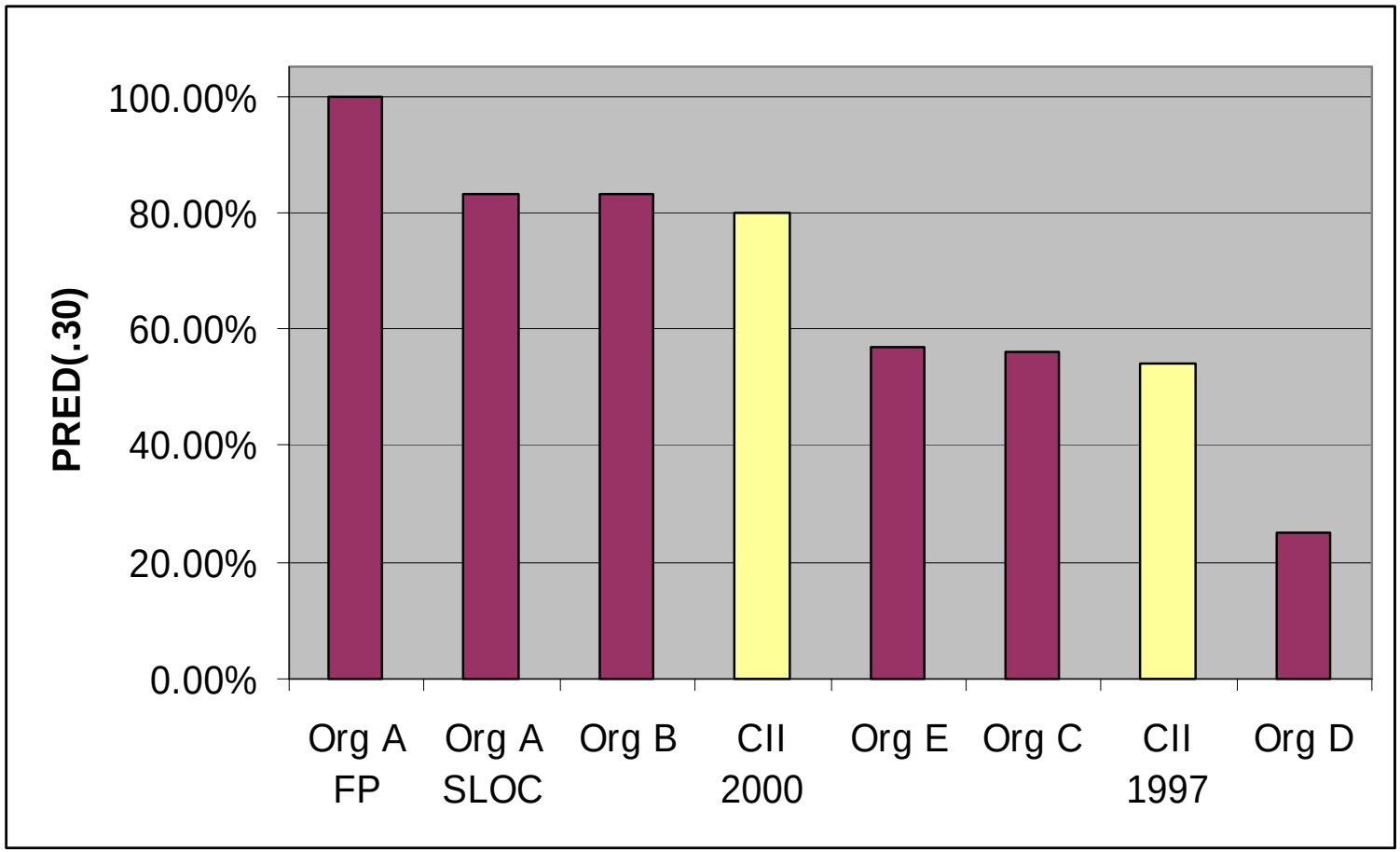
Study Results
Organization E

- A large project may have strongly influenced the model
- Largest EAF variation observed
- (Re)define project categories, add projects, and recalibrate



Conclusions and Future Work

Conclusions and Future Work
Using Original CII Calibration as a Baseline



Original COCOMO II calibrations provide a baseline for assessing local calibrations

Conclusions and Future Work
Difficulties, Lessons Learned and Recommendations

- Topics
  - **Obtaining a set of completed projects**
  - **Measuring or estimating size**
    - NESMA approach
  - **Obtaining values for effort and schedule**
  - **Dealing with subjectivity in cost driver rating**
    - The importance of local standards
    - Monte Carlo may help deal with uncertainty

Conclusions and Future Work
Future Work

- Help organizations to:
  - **Add more projects & recalibrate models**
  - **Calibrate new models for other categories**
  - **Create local standards for cost driver rating**
  - **Group projects into categories for model building**
  - **Implement COCOMO II estimation processes**

Thank You!

Mauricio Aguiar

ti MÉTRICAS

mauricio@metricas.com.br

www.metricas.com.br